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FOREST RESOURCES of SOUTHERN MONTANA

by

W. C. Hodge – C. W. Brown
and T. L. Finch

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UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE

STATION PAPER NO. 20

MAY 1949

Prepared by the Division of Forest Economics

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Statistical and inventory procedures were the responsibility of P. D. Kemp.

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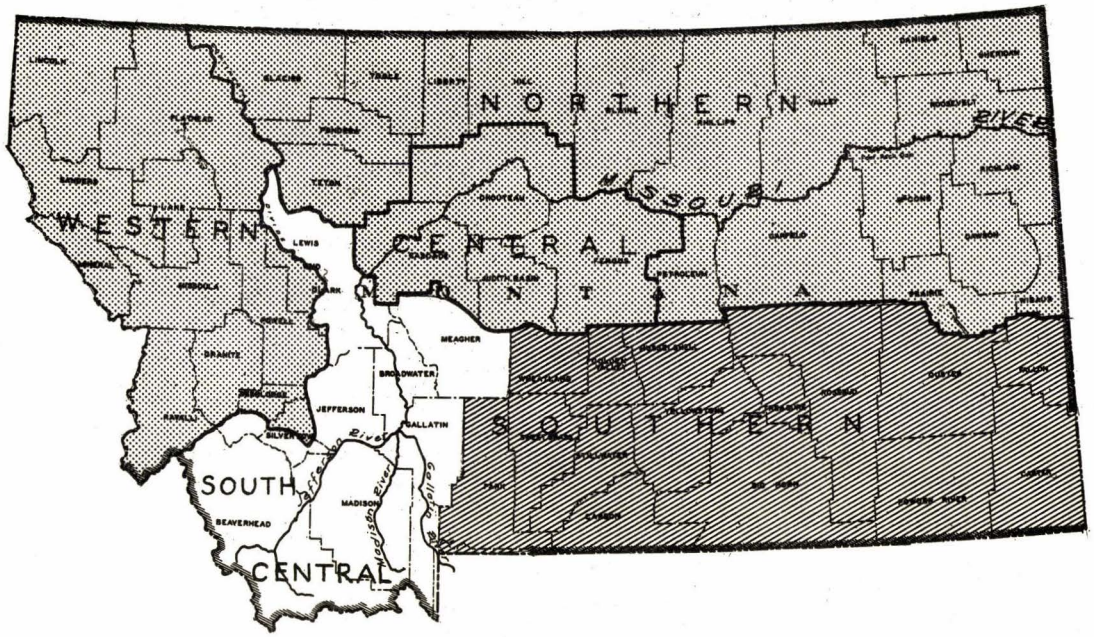
THE FOREST SURVEY IN MONTANA

A survey of Montana's forests was begun in 1934 as a part of a Nation-wide inventory of the forest resources. Interrupted by the war, this survey was resumed in 1946 and is now about 90 percent complete. Present plans contemplate finishing the survey in 1949 to give Montana the first real measure of its forest wealth. Statistics for 23 counties in Northern and Central Montana and for that portion of the state west of the Continental Divide have been published previously.

This report presents basic inventory data on the extent of the forest land and the timber volume for 15 Southern Montana counties as indicated on the map below. These counties were covered by the forest survey in 1948. A survey of South Central Montana is now under way. Upon completion of the survey, a comprehensive report, including data on forest growth and drain, is planned for all of the Montana units.

FOREST SURVEY UNITS



AREA COVERED IN THIS REPORT

AREA COVERED IN PREVIOUS REPORTS

FOREST LAND

Southern Montana has over two million acres of forest land. About 10 percent of the area is forested. All of the 15 counties in this southern unit have some forest land. Park County with 705,000 acres of forest has the largest forest area. Sweetgrass County is second with 270,000 acres. Fallon County with less than a thousand acres has the smallest forest acreage. Within this unit is the principal forested area at the headwaters of the Yellowstone River.

The forest area in the eastern portion of the southern unit consists typically of open scattered ponderosa pine stands in the uplands and stringers of cottonwood along the waterways. Historically these forests provided fuel, shelter, and fence posts for many of the early settlers. As the Northern Pacific Railway pushed west, the forests provided many of the necessary ties and construction timbers. Because of the semiarid climatic conditions the people living in this eastern part have a deep appreciation of trees that is so frequently lacking in more extensively forested areas.

The western portion of the southern unit contains some of the roughest topography in the state. Granite Peak, 12,850 feet in elevation, the highest point in Montana, towers above this rugged domain. The forests are predominantly coniferous - lodgepole pine and Douglas-fir. Early use of the forest was principally for hewn railroad ties. Nearly every creek draining into the Yellowstone shows evidence of work by early day tie-cutters. For scenic beauty the area is outstanding and recreation is big business throughout most of the unit.

10% OF THE TOTAL AREA IS FOREST LAND

3/4S OF THE FOREST LAND IS CLASSED AS COMMERCIAL

96 % OF THE COMMERCIAL FOREST LAND IS SOFTWOODS, 4 % IS HARDWOODS

TIMBER VOLUME

Coniferous timber makes up almost all of the timber volume in the southern unit. From Musselshell and Yellowstone Counties east to the state boundary are scattered stands of ponderosa pine. Juniper is sparsely intermingled with the pine. West of these counties mountain forest types predominate. Douglas-fir, lodgepole pine, spruce, whitebark pine, limber pine and alpine fir are found throughout this western section.

Small stands of hardwood occur throughout the unit along river bottoms. Cottonwood is common to all counties; green ash and box elder are widely distributed in the prairie counties; and aspen occurs along the edges of the mountain forest. Cottonwood is the only hardwood present in appreciable quantity.

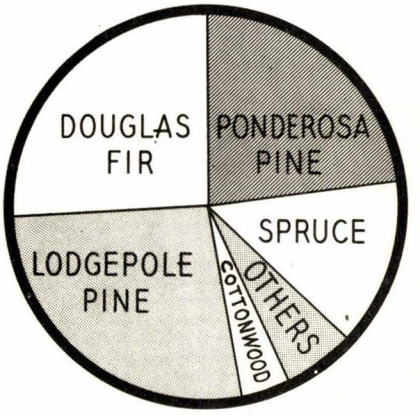
Altogether there are slightly more than four billion board feet of saw timber on the commercial forest land. Over three-fourths of the board-foot volume is in saw-timber stands; the remainder is in stands which are predominantly pole-size trees, in open woodland, and as residual volume in very young stands. Four fifths of the board-foot volume in saw-timber stands is in trees 11 to 21 inches in diameter breast high (d.b.h.).

Twenty-eight percent of the total cubic-foot volume is lodgepole pine; 26 percent, ponderosa pine; 25 percent, Douglas-fir; 8 percent, spruce; 7 percent, whitebark and limber pine; 3 percent, cottonwood; and 3 percent, miscellaneous species. Juniper is included in the miscellaneous species, but it has a value out of proportion to its volume. It is prized as fence post material, and in tourist centers such as Red Lodge souvenirs made of juniper are offered for sale at handsome prices. The next 3 pages illustrate the kind and quality of timber that is common to the southern unit.

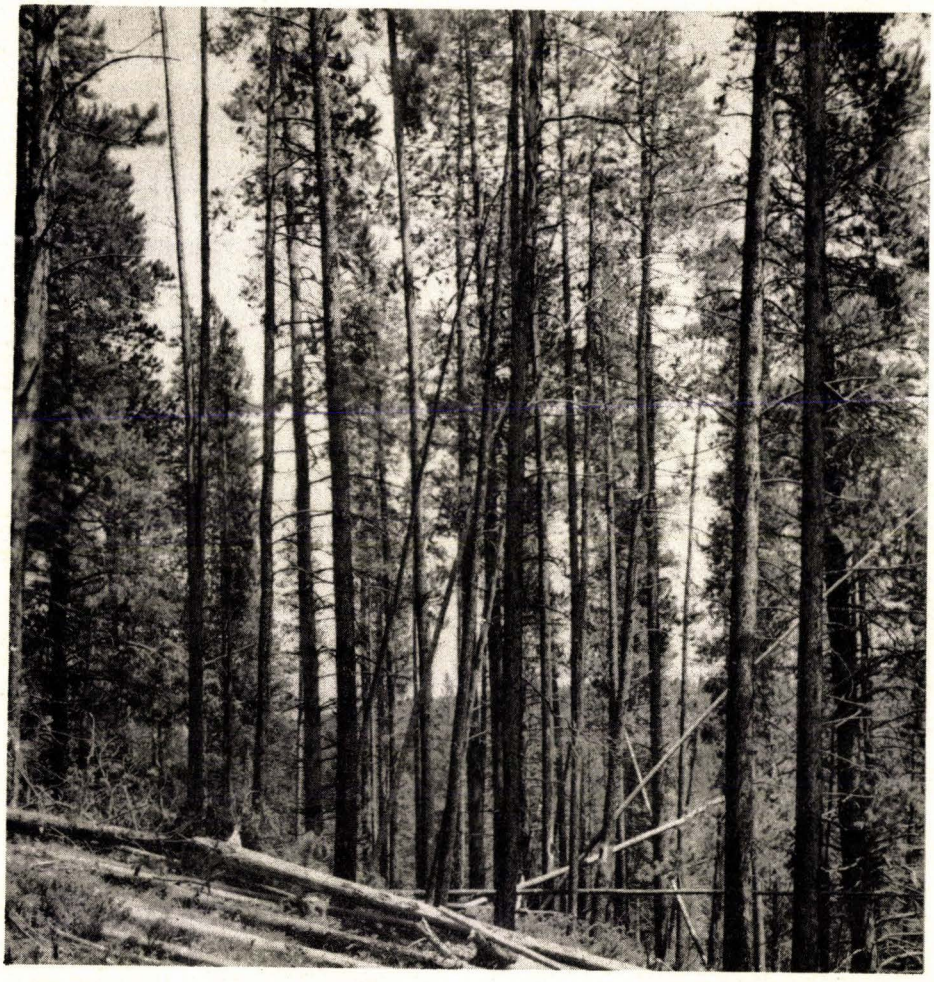
SOFTWOOD SPECIES MAKE UP **96 %** OF THE BOARD-FOOT AND CUBIC-FOOT VOLUME

2 COUNTIES IN THE UNIT HAVE **2/3**S OF THE VOLUME

THREE SPECIES MAKE UP **75%** OF THE BOARD-FOOT VOLUME



LODGEPOLE PINE IN THE NORTHERN ROCKIES



Pure stands of lodgepole pine are found in all of the mountain ranges west of Billings. The Beartooth and Absaroka mountains have the biggest concentrations of timber in the Southern Montana unit, and a large part of this is lodgepole. These lodgepole stands are usually even-aged, and occur in all stands due to the recurring fires which precede establishment of a pure stand of lodgepole. Shown here is a saw-timber stand about 160 years old. Lodgepole pine, long a favorite of the early-day "tie-hacks" is currently in demand for transmission poles and pulpwood.

PONDEROSA PINE SAW TIMBER IN THE SEMIARID TYPE

Ponderosa pine occurs over much of the eastern section of the southern unit in stands that are frequently broken by rim rocks and grassy mesas. Saw timber such as shown above is found in Carter, Powder River, Rosebud, and Big Horn Counties mainly within the Custer National Forest and the Tongue River Indian Reservation. Ponderosa pine is found also in the Bull Mountain area of Yellowstone and Musselshell Counties. There are over one-half million acres in the unit capable of producing this kind of saw timber. Most of the area is a poor growing site but intermingled with the poor sites are better sites growing trees of larger size and better quality than illustrated above. Lumber production by small sawmills operating in these forests and producing mostly for local ranch use has been increasing in the postwar years.

COTTONWOOD IN STREAM BOTTOM STRINGER TYPE

Cottonwood is found in all counties of the Southern Montana unit. The quality varies widely from county to county. Cottonwood occurs only along the waterways, and the best of it is along large rivers such as the Yellowstone, Powder, Tongue, Big Horn, Clark Fork of the Yellowstone, Stillwater and Boulder. With the passing of the river boats and the demand for fuelwood, there has been little commercial use of cottonwood. Interest in this species is awakening again and a few portable mills have cut some lumber in recent years for construction of ranch buildings.

Table 1. Forest land area

County	Total area 1/	Total forest land	Commercial forest land		
			Total	Softwood	Hardwood
	Acres				
Big Horn	3,221,120	201,566	179,185	172,622	6,563
Carbon	1,324,800	185,589	86,793	81,246	5,547
Carter	2,120,320	56,527	56,527	52,607	3,920
Custer	2,409,600	25,092	25,092	22,346	2,746
Fallon	1,045,120	378	378	-	378
Golden Valley	753,920	34,263	19,921	18,910	1,011
Musselshell	1,207,040	247,381	247,381	246,783	598
Park	1,681,280	705,442	398,100	392,891	5,209
Powder River	2,102,400	198,980	196,791	180,832	15,959
Rosebud	3,220,480	152,603	151,941	150,807	1,134
Stillwater	1,150,080	222,238	124,154	120,522	3,632
Sweetgrass	1,181,440	269,135	172,796	156,857	15,939
Treasure	629,760	24,418	24,418	23,311	1,107
Wheatland	912,000	53,849	25,256	23,945	1,311
Yellowstone	1,686,400	58,587	58,412	56,055	2,357
Total	24,645,760	2,436,048	1,767,145	1,699,734	67,411
Percent of total	100.0	9.9	100.0	96.2	3.8

1/ Areas of the United States, 16th Census of United States, 1940.

Table 2. Timber volume

County	Saw timber 1/			All timber 2/		
	Softwood	Hardwood	Total	Softwood	Hardwood	Total
	M board feet			M cubic feet		
Big Horn	107,793	5,552	113,345	67,804	3,730	71,534
Carbon	103,951	3,664	107,615	69,047	4,011	73,058
Carter	104,923	6,408	111,331	31,303	2,535	33,838
Custer	17,824	8,869	26,693	8,773	2,373	11,146
Fallon	-	664	664	-	183	183
Golden Valley	13,647	2,861	16,508	8,368	871	9,239
Musselshell	271,349	2,495	273,844	105,051	662	105,713
Park	2,352,764	10,385	2,363,149	756,591	4,169	760,760
Powder River	164,661	44,377	209,038	66,856	11,960	78,816
Rosebud	114,935	4,131	119,066	49,503	1,179	50,682
Stillwater	120,190	2,416	122,606	69,650	1,294	70,944
Sweetgrass	513,801	50,360	564,161	194,881	14,204	209,085
Treasure	15,038	4,734	19,772	6,749	1,246	7,995
Wheatland	33,916	3,593	37,509	19,638	1,161	20,799
Yellowstone	53,488	8,727	62,215	21,618	2,364	23,982
Total	3,988,280	159,236	4,147,516	1,475,832	51,942	1,527,774
Percent of total	96.2	3.8	100.0	96.6	3.4	100.0

1/ Trees 11.0 inches and larger in diameter as measured by International 1/4" rule.

2/ The volume, excluding bark, of sound trees and the sound volume of cull trees from 1-foot stump to a 4.0-inch minimum top diameter including the sound volume of limbwood for hardwood species to a 4.0-inch minimum top diameter.

STANDARD STATISTICAL DATA FOR UNIT
SOUTHERN MONTANA

Table 3. Land area by major use

Major use	Acres	Percent
Forest land	2,436,048	9.9
Nonforest land 1/	22,209,712	90.1
Total	24,645,760	100.0

1/ Includes water areas.

Table 4. Forest land area by economic class

Economic class		Acres	Percent
Commercial forest land		1,767,145	72.5
Noncommercial forest land			
Withdrawn 1/	37,830		
Other 2/	631,073	668,903	27.5
Total		2,436,048	100.0

1/ Commercially valuable forest land withdrawn from commercial use for parks, reserves, wilderness areas, etc.

2/ Remote and inaccessible alpine areas, and other land which owing to very low productivity, excessively poor quality timber, or extreme inaccessibility appears to be permanently out of the commercial timber producing class.

Table 5. Commercial forest land by species group and stand-size class

Species group and stand-size class	Acres	Percent
Softwood		
Saw timber	389,335	22.0
Pole	836,053	47.3
Seedling-sapling	157,366	8.9
Poorly stocked and denuded	316,980	18.0
Total	1,699,734	96.2
Hardwood		
Saw timber	23,730	1.4
Pole	33,724	1.9
Seedling-sapling	5,940	.3
Poorly stocked and denuded	4,017	.2
Total	67,411	3.8
Total		
Saw timber	413,065	23.4
Pole	869,777	49.2
Seedling-sapling	163,306	9.2
Poorly stocked and denuded	320,997	18.2
Total	1,767,145	100.0

Table 6. Board-foot volume on commercial forest land by species

Species	Volume	
	M board feet	Percent
Softwood		
Ponderosa pine	953,567	23.0
Douglas-fir	1,082,760	26.1
Alpine fir	61,303	1.5
Engelmann spruce	593,019	14.3
Lodgepole pine	1,097,009	26.5
White bark and limber pine	200,622	4.8
Subtotal	3,988,280	96.2
Hardwood		
Cottonwood	156,907	3.8
Boxelder	1,471	1/
Green ash	858	1/
Subtotal	159,236	3.8
Total	4,147,516	100.0

1/ Less than 0.1 percent.

Table 7. Cubic-foot volume on commercial forest land by species

Species	Volume	
	M cubic feet	Percent
Softwood		
Ponderosa pine	401,815	26.3
Douglas-fir	382,167	25.0
Alpine fir	33,356	2.2
Engelmann spruce	129,017	8.4
Lodgepole pine	421,240	27.6
White bark and limber pine	105,306	6.9
Juniper	2,931	.2
Subtotal	1,475,832	96.6
Hardwood		
Aspen	4,195	.3
Cottonwood	42,745	2.8
Boxelder	2,347	.1
Green ash	2,655	.2
Subtotal	51,942	3.4
Total	1,527,774	100.0

Table 8. Board-foot volume on commercial forest land by stand-size class and diameter group

Stand-size class	Volume by diameter group (Inches)			Total
	12 - 20	22 - 30	32 - 40	
	M board feet			
Saw timber	2,643,204	598,409	21,758	3,263,371
Pole	655,244	60,141	2,485	717,870
Seedling-sapling	25,710	1,144	-	26,854
Poorly stocked and denuded	129,857	9,564	-	139,421
Total	3,454,015	669,258	24,243	4,147,516

Table 9. Cubic-foot volume on commercial forest land by stand-size class and diameter group

Stand-size class	Volume by diameter group (Inches)				Total
	6 - 10	12 - 20	22 - 30	32 - 40	
	M cubic feet				
Saw timber	195,346	515,345	108,525	5,207	824,423
Pole	456,341	149,040	11,514	779	617,674
Seedling-sapling	8,055	6,087	259	-	14,401
Poorly stocked and denuded	36,413	31,627	3,236	-	71,276
Total	696,155	702,099	123,534	5,986	1,527,774

Table 10. Cubic-foot volume on commercial forest land by species group, tree size, and class of material

Tree size and class of material	Volume by species group		
	Softwood	Hardwood	Total
	M cubic feet		
Saw-timber trees			
Sawlog portion 1/	675,016	25,255	700,271
Other 2/	118,781	12,569	131,350
Subtotal	793,797	37,824	831,621
Pole trees 3/	682,035	14,118	696,153
Total	1,475,832	51,942	1,527,774

1/ Sound trees only.
2/ Upper stems of sound trees, usable volume of cull trees, and limbwood of hardwood species.
3/ Sound and cull trees.

Table 11. Average volume per acre by stand-size class

Stand-size class	Average volume per acre	
	Board feet	Cubic feet
Saw timber	7,900	1,996
Pole	825	710
Seedling-sapling	164	88
Poorly stocked and denuded	434	222
All stands	2,347	865

DEFINITIONS

Following are definitions of terms used in this report:

Area Classes

Forest land is land bearing forest growth or land from which the forest has been removed but which shows evidence of past forest occupancy and which is not now in other use.

Commercial forest land is forest land bearing or capable of bearing timber of commercial character and economically available now or prospectively for commercial use and not withdrawn from such use.

Noncommercial forest land is (1) commercially valuable forest land actually withdrawn from commercial use for parks, reserves, wilderness areas, etc., and (2) remote and inaccessible alpine areas, and other land which owing to very low productivity, excessively poor quality timber or extreme inaccessibility appears to be permanently out of the commercial timber-producing class.

Softwood forest consists of stands with 25 percent or more of ponderosa pine or 50 percent or more of other coniferous species. (Based on cubic-foot volume.)

Hardwood forest consists of stands with less than 25 percent of ponderosa pine and 50 percent or more hardwood species. (Based on cubic-foot volume.)

Stand-size Classes

Saw-timber stands include stocked areas with a plurality of the total net cubic volume in trees 11.0 inches and larger in diameter and generally with 2,000 board feet per acre or more in saw-timber trees.

Pole stands include stocked areas in which a plurality of the total cubic-foot volume is in trees from 5.0 inches in diameter to saw-timber size.

Seedling-sapling stands include stocked areas in which the plurality of the total cubic-foot volume is in trees less than 5.0 inches in diameter.

Poorly stocked and denuded stands include areas with less than: (a) 2,000 board feet per acre, (b) 10 percent stocking of pole trees, and (c) 10 percent stocking of seedling-sapling trees.

FOREST SURVEY METHOD

A. The forest resource statistics in this report are based on a field survey made during 1947. Briefly the method used in making this survey was as follows:

1. The forest area was determined by an area sampling system which involved measuring and classifying systematically distributed sample segments.

2. The timber volume was determined by measuring the trees found on randomly selected one-fifth acre plots located within the sample segments

B. The basic data from which the area and volume were determined consisted of the following field samples:

Class	Area		Volume	
	Number of sample segments	Area per sample segment (acres)	Number of plots	Area per sample plot (acres)
I	234	2,560	702	1/5
II & III	193	640	382	1/5

C. Distribution of the area sample segments and volume plots was controlled by the following method:

1. The entire area was divided on 1-inch-to-the-mile base maps into three primary classes:

Class I Areas predominantly forest for which aerial photographs were available.
Class II Areas predominantly nonforest for which aerial photographs were available at moderate cost.
Class III Areas predominantly nonforest for which aerial photographs cost more than $2 per print, or for which there were no aerial photographs.

2. Each of the three primary classes were further subdivided into units in the following manner: Beginning with a random selection, Land Office section corners were marked on a base map at 4-mile intervals for areas in Class I, 7-mile intervals

for areas in Class II, and 10-mile intervals for areas in Class III. Thus, the three classes were subdivided into units containing approximately 16, 49, and 100 square miles respectively, each unit centered on one of the section corner control points.

3. The control points were transferred to aerial photo index maps from which photographs were selected to give photo coverage for a segment of each unit containing forest land. For Class-I units the sample segments consisted of four Land Office sections (2,560 acres) centered on the control point, for Class-II and -III units the sample segments consisted of one section (640 acres) lying northeast of the control point.

4. All sample segments containing commercial forest land, including those with doubtful forest cover by photo interpretation and all sample segments without aerial photographs, were examined and mapped in the field. For each sample segment the forest cover was stratified by commercial character, forest type, stand-size, stocking, age, and site classes. The area of these stratifications was determined for each mapped sample segment and as refined by line transects was multiplied by sample factors (the area of a class divided by the area sampled in that class) to get the total area by forest condition classes.

5. Timber volume was tallied on three 1/5-acre sample plots in each sample segment of Class I, and two 1/5-acre plots in the sample segments of Classes II and III. The plots were randomly located within the sample segments. Plot volumes when averaged for a given forest condition were multiplied by the area to determine the total timber volume.

ACCURACY OF THE DATA

In determining the extent of various cover types and stand-condition classes, there are two possible sources of error: (1) errors in classifying the cover of the field samples and in compiling the field data, and (2) sampling errors. The former result from mistakes of judgment or technic and the complexity of the cover which not infrequently grades from one class into another with no clearly defined boundaries. These errors were minimized by the exercise of care and skill, but it is seldom possible to evaluate them. An effort was made to maintain a high order of accuracy and uniformity of standards in the classification, collection, and compilation of sample data, by field checks, by a continuing program of training, and by cross checks in the office.

Sampling errors (standard errors of estimate) on the other hand do not involve human errors but rather are theoretical measures of the reliability of estimates based on the variability exhibited by sample measurements. They generally vary inversely with the square root of the number of samples and directly with the square root of the unsampled proportion of the total population. Hence, they can be controlled by altering either the number of samples, the size of individual samples, or both.

Analysis of sample variations indicate that the standard errors of estimate for the unit as a whole are ± 3.5 percent for total forest, ± 5.1 percent for commercial forest, and ± 6.6 percent for noncommercial forest. Accordingly, the probabilities are 2 out 3 that the actual forest, commercial forest, and noncommercial forest land areas are, respectively, within ± 85,000, ± 90,000, and ± 44,000 acres of the estimated areas if measurements and computed errors introduced no bias.

In determining timber volumes, the possible sources of error include in addition to those cited above (3) inaccurate measurement of sample plots, tree diameters, tree heights, and cull, and (4) bias resulting from improper construction, selection, and use of tree-volume tables. All reasonable effort was made to eliminate errors from these sources. The standard error of the board-foot volume estimate for the block as a whole is ± 7.8 percent and of the cubic-foot volume estimate, ± 6.8 percent. Accordingly, the probabilities are 2 out of 3 that the actual volumes are within ± 324,000 M board feet and ± 104,000 M cubic feet of the given estimates.

The reliability of one statistic as compared with another presented in the same or a related table can be judged roughly by its relative magnitude. In general, the larger quantities warrant greater confidence; the smaller quantities indicate only relative magnitude. This fact should be borne in mind in considering the small quantities associated with many of the counties covered in this report.

LIST OF FOREST SURVEY REPORTS FOR MONTANA

No.	Forest Survey Statistical Service Series
2	Forest statistics for Lincoln County, 1941.
3	Forest statistics for Flathead County, 1941.
4	Forest statistics for Lake County, 1941.
5	Forest statistics for Sanders County, 1941.
6	Forest statistics for Mineral County, 1941.
7	Forest statistics for Ravalli County, 1941.
8	Highlights of the Missoula County forest situation, 1942.
9	Highlights of the forest situation in Lewis and Clark County (west of the Continental Divide), 1942.
10	Highlights of the forest situation in Deerlodge County (west of the Continental Divide), 1942.
11	Highlights of the forest situation in Silver Bow County (west of the Continental Divide), 1942.
12	Highlights of the Powell County forest situation, 1942.
13	Highlights of the Granite County forest situation, 1942.
14	Highlights of the forest situation in western Montana, 1943.
15	Highlights of the forest situation in Chouteau County, 1943.
16	Highlights of the forest situation in Fergus County, 1943.
17	Highlights of the forest situation in Judith Basin County, 1943.
18	Highlights of the forest situation on the national forests of western Montana, 1944.

Forest Survey Releases

20	The forest situation in Lincoln County, July 1943.
21	The forest situation in Ravalli County, July 1943.

Station Papers

12	Forest resource statistics Cascade County, by H. J. Pissot and E. F. Peffer, April 1948.
13	Forest resources of Northern Montana, by C. W. Brown and W. C. Hodge, June 1948.
20	Forest resources of Southern Montana, by W. C. Hodge, C. W. Brown and T. L. Finch, May 1949.

LIST OF PREVIOUS PUBLICATIONS IN THIS SERIES

Station Paper No.	
1	* A preliminary study of root diseases in western white pine, by John Ehrlich. Oct. 1939.
2	* Possibilities of partial cutting in young western white pine, by E. F. Rapraeger. Jan. 1940.
3	Blister rust control in the management of western white pine, by Kenneth P. Davis and Virgil D. Moss. June 1940.
4	Possibilities of wood-pulp production in the northern Rocky Mountain region, by E. F. Rapraeger. Mar. 1941.
5	Results to date of studies of the durability of native woods treated and untreated, by C. N. Whitney. Rev. Jan. 1946.
6	Changes in Benewah County forest statistics, by Paul D. Kemp. July 1947.
7	A guide for range reseeding on and near the national forests of Montana, by C. Allan Friedrich. Oct. 1947.
8	Pole blight - a new disease of western white pine, by C. A. Wellner. Nov. 1947.
9	Management practices for Christmas tree production, by C. A. Wellner and A. L. Roe. Nov. 1947.
10	The merits of lodgepole pine poles, by I. V. Anderson. Nov. 1947.
11	Tables for approximating volume growth of individual trees, by P. D. Kemp and M. E. Metcalf. Mar. 1948.
12	Forest resource statistics, Cascade County, Montana, by H. J. Pissot and E. F. Peffer. Apr. 1948.
13	Forest resources of northern Montana, by C. W. Brown and W. C. Hodge. June 1948.
14	List of publications available for distribution or loan, 1910 through 1947. NRM station. June 1948
15	Review of published information on the larch-Douglas fir forest type, by Russell K. LeBarron. Nov. 1948.
16	Development of a blister rust control policy for the national forests in the Inland Empire, by Donald N. Matthews and S. Blair Hutchison. Dec. 1948.

* Out of print. Loan copies may be obtained upon request.